February 23, 1967

MEMORANDUM TO: S. L. Davies, Director

SUBJECT: Pine Bluff Arsenal Fishkill

EXPOSITION

On Tuesday, January 31, the Provost Marshall's Office at the Pine Bluff Arsenal reported that a fishkill had occurred in Yellow Lake, a small river lake located on the Arsenal reservation. K. E. Sorrells and N. M. Woomer went to the Arsenal and were accompanied from the Provost Marshall's Office to the lake by Sgt. England, the Arsenal Warden.

The water level in the lake was up considerably do to a very heavy rainstorm the previous Thursday. The lake was described as being shallow, always turbid, and about 100 acres in area. Accurate depth and dimension figures could not be obtained. The sole tributary is a small drainage ditch which runs into the lake in the Northwest sector (see map). The water flows out at about the same rate at a point in the southeast sector. At that point dead fish, mostly small to medium-sized shad and a number of small catfish, lined the bank, about 5-8 fish per yard. The rapidly decomposing fish had apparently been dead at least three days. Along the east shore in several small inlets, 15 to 25 dead fish per yard were found. The majority of these fish had also been dead several days. One dying seven inch catfish was brought back to the lab for autopsy, which revealed rather massive bleeding into the body cavity. This bleeding was certainly a significant factor in the death of that particular fish, but it could not be said to shed any etiological light on the death of the other fish.

The above-mentioned ditch feeding the lake receives waste from a munitions factory a short distance north of the lake. This waste contains high concentrations of colloidal white phosphorus. A sample from this stream was taken just before it enters the lake. Near the stream the typical garlic-like odor of white phosphorus was almost overpowering. Also, a testing area for smoke bombs is located on the west bank of the lake. When it rains, this area is thoroughly washed down and the drainage goes into the lake. The principal possible toxic substance which might be contained in this

drainage is hexachloroethane, a component of artificial smoke mixtures.

A report by the Army Materiel Command on waste treatment facilities appurtenant to the Pine Bluff Arsenal, dated July 1966, says that the waste containing white phosphorus particles that are lost during the munitions loading process are treated by a plant consisting of a small holding pond and filter bed. That this treatment is inadequate is attested to by the statement in the report that a new facility with a larger holding pond and a primary and secondary filter bed plus a sand filter is scheduled to replace the existing plant. Just when this new plant is to be constructed is not clear.

SAMPLING AND ANALYSIS

The attached map shows the sample point locations and numbers. The results of the analyses preformed on these samples follow. Total phosphates were checked after digestion of the sample with sulfuric acid.

	pH	Total Alkalinity	Chlorides	Dissolved Oxygen	Total Phosphates
#1	7.4	59ppm	114ppm	8.3ppm	10.35ppm
#2	7.5	58ppm	118ppm	9.3ppm	9.25ppm
#3	7.2	52ppm	130ppm	6.2ppm	27.50ppm
#4	7.0	77ppm	2ppm	5.9ppm	83.75ppm
#5	7.0	50ppm	37ppm	-	27.50ppm

SUMMARY AND CONCLUSIONS

Phosphates, per se, are not ordinarily toxic to aquatic life; indeed, a certain concentration (about 0.1 ppm in normal lakes) is necessary for growth and development of aquatic organisms. But elemental phosphorus is very toxic and this is undoubtedly the form in which most of the phosphorus is found in Yellow Lake. Elemental phosphorus oxidizes readily in air, but not under water. Phosphorus in concentrations such as are found in Yellow Lake, if oxidized, would exert an enormous oxygen demand on the water. The observed quite normal dissolved oxygen levels, even in the waste ditch itself, indicate that the colloidal phosphorus does not oxidize to any great degree in the water.

Toxicity studies of colloidal elemental phosphorus to bluegill sunfish reported in California Water Quality Criteria concluded that "the TL_m of colloidal P_4 is not greater than 0.104ppm at 48 hrs. nor less than 0.025ppm at 163 hrs." A ten to hundred fold increase in the larger amount almost surely existed in Yellow Lake at the time of the fishkill.

The activities which result in the phosphorus waste going into the lake have been going on at the Arsenal for many years, and the lake fauna has undoubtedly become somewhat acclimated to the phosphorus when it is present in smaller amounts. However, there is reason to believe that perhaps munitions production has been stepped up due to the Vietnamese war. Information on production, possible spills, etc. could not be obtained due to the Arsenal's strict security regulations.

The values obtained for total phosphates in all parts of the lake support the conclusion that the fish died from phosphorus poisoning, probably in combination with other traumatic environmental disturbances caused by the previous Thursday's heavy rainstorm, and the associated runoff from the smoke bomb testing area. Such fishkills will very probably continue to occur periodically until the improved white phosphorus waste treatment facility is installed.

Neil Woomer
Biologist

NW:sw
cc: Sgt. England
Provost Marshall's Office
Pine Bluff Arsenal
Pine Bluff, Arkansas

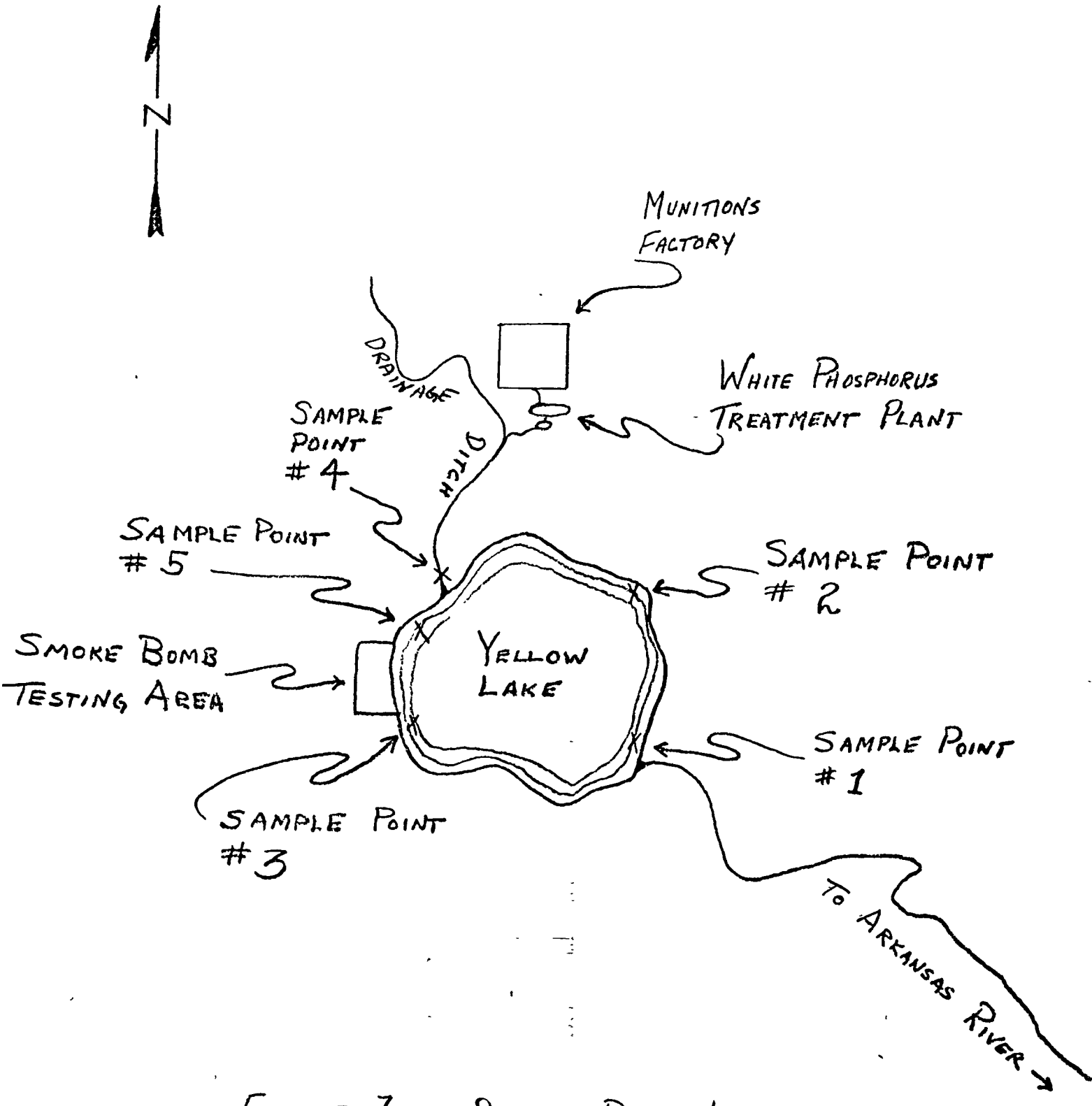

FIGURE 1. SAMPLE POINT LOCATIONS
YELLOW LAKE FISHKILL
PINE BLUFF ARSENAL